
Developing an Evaluation Framework for Assessing Ecosystem Services in Agricultural Heritage Sites

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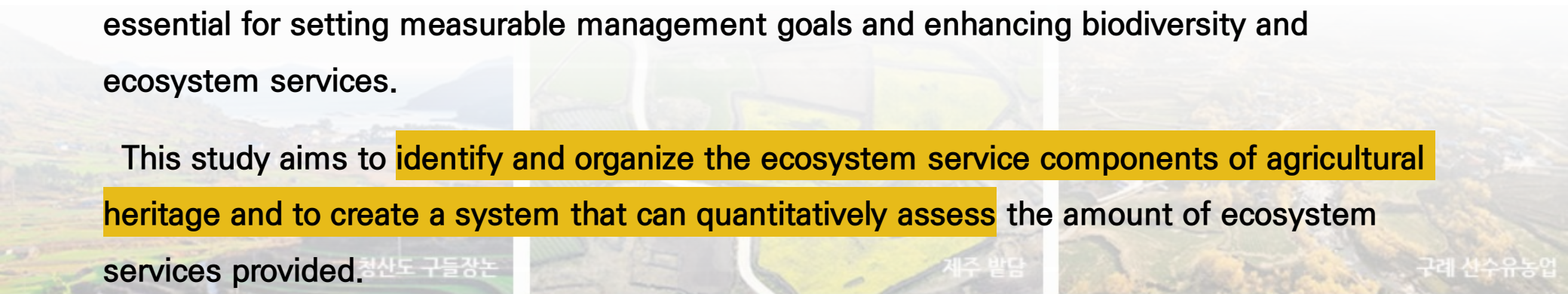
06 Discussion

The designation of National Important Agricultural Heritage Systems (KIAHS) in Korea has been active. However, the management and operational plans after designation often lack detail and a systematic approach.

As of 2024, Korea has designated 18 National Important Agricultural Heritage Systems and 5 Global Important Agricultural Heritage Systems.

Understanding the ecosystem services provided by these agricultural heritage sites is essential for setting measurable management goals and enhancing biodiversity and ecosystem services.

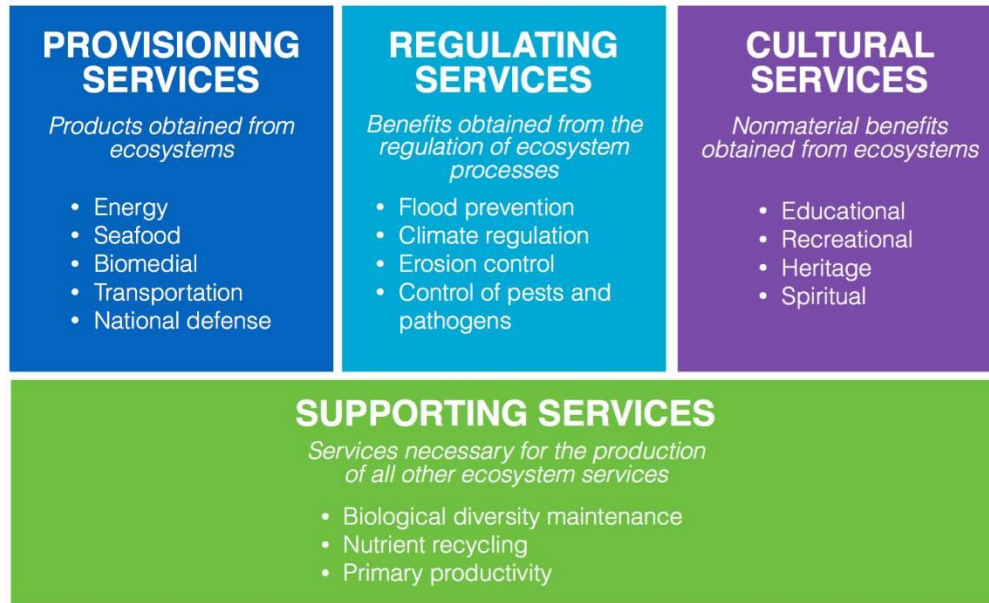
This study aims to identify and organize the ecosystem service components of agricultural heritage and to create a system that can quantitatively assess the amount of ecosystem services provided.



| Ecosystem Services Defined and Valued

Ecosystem services are the benefits humans gain from healthy ecosystems. Recognizing these services in agricultural heritage systems can guide better conservation and sustainable management

These services include provisioning (food and water), regulating (climate, flood, and disease control), supporting (soil formation and nutrient cycling), and cultural (recreational, aesthetic, and spiritual benefits).



source: Final Recommendations of the Interagency Ocean Policy Taskforce, 2010



| Developing an Evaluation Framework

To effectively manage and enhance the value of KIAHS, it is crucial to develop a robust framework for identifying and systematizing the elements of ecosystem services these heritage sites provide.

The aim is to establish a system that can measure the amount of ecosystem services in a way that is meaningful for policy-making and conservation efforts.

Identification of Ecosystem Service Components

Cataloguing the benefits and services KIAHS offer, such as traditional farming techniques that boost biodiversity and landscape features that regulate local climates

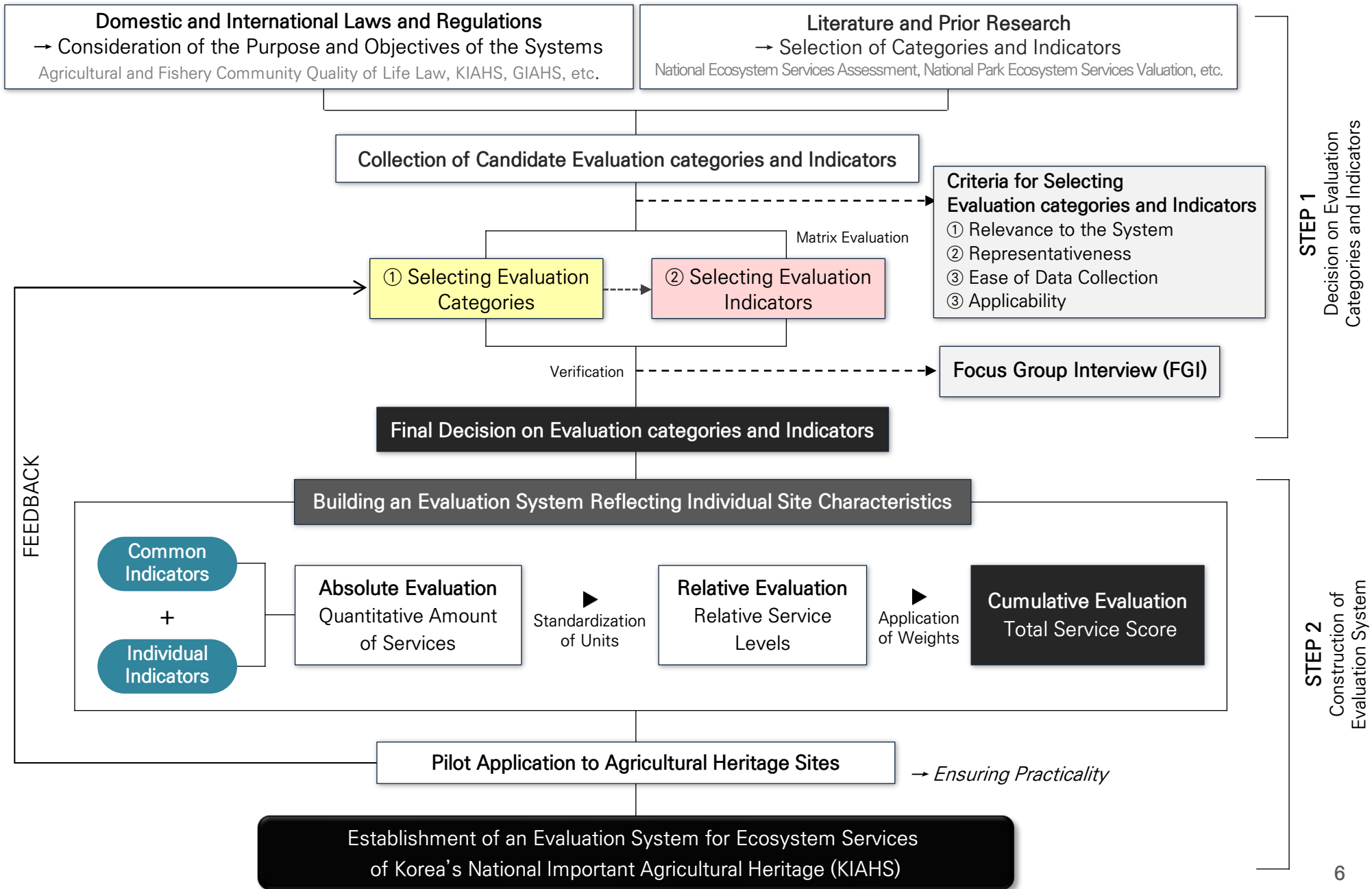
Systematization of Components

Structuring these services into a clear framework that meets both national and international standards for ecosystem service evaluation

Quantitative Evaluation of Components

Developing indicators and metrics to quantitatively assess these services, measuring aspects like biodiversity preservation, carbon sequestration, and the impact on local water quality

02 Research Framework and Methods

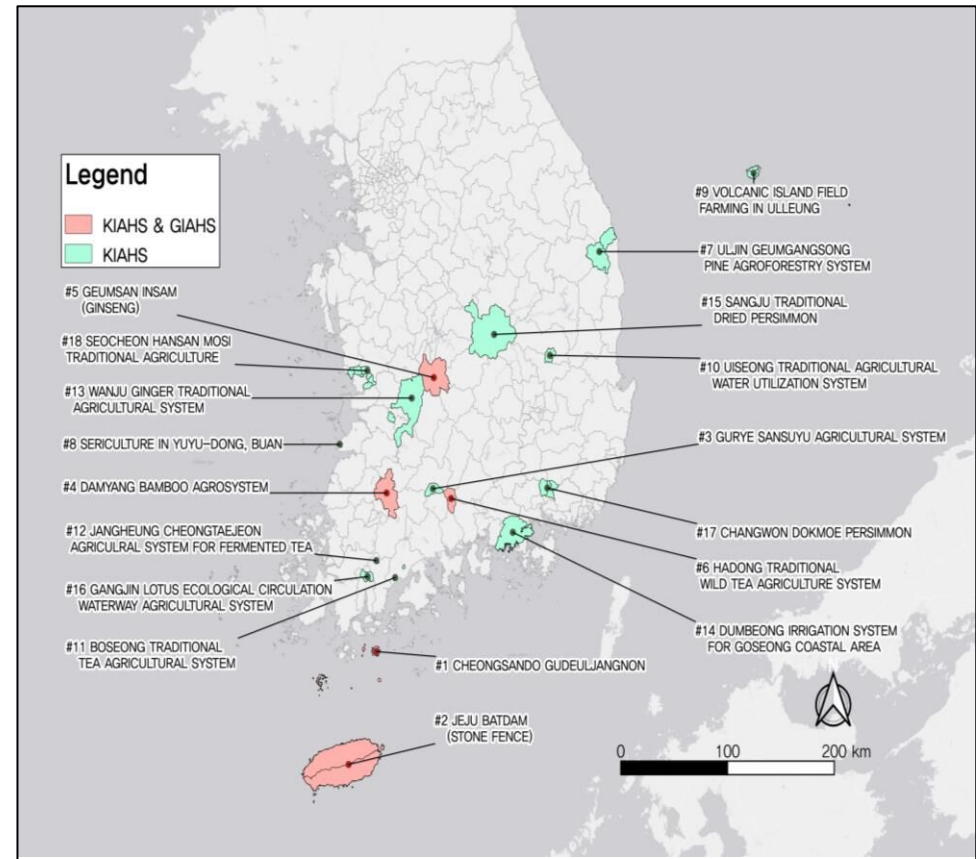


03 Research Sites

Designation Number	Name	Designated Area
No.1('13)	Cheongsando Gudeuljang Rice Terraces	4,147ha
No.2('13)	Jeju Batdam Stone Walls	56,355ha
No.3('14)	Gurye Sansuyu (Cornelian Cherry) Farming	10,133ha
No.4('14)	Damyang Bamboo Field Farming	2,599ha
No.5('15)	Geumsan Insam(Ginseng) Farming	57,570ha
No.6('15)	Hadong Traditional Tea Farming	597.8ha
No.7('16)	Uljin Geumgang Pine Forest Farming	14,188ha
No.8('17)	Buan Yuyudong Sericulture System	58.9ha
No.9('17)	Ulleung Volcanic Island Dry Field Farming System	7,286ha
No.10('18)	Uiseong Traditional Irrigation Agricultural system	25,665ha
No.11('18)	Boseong Traditional Tea Agricultural System	222.8ha
No.12('18)	Jangheung Fermented Tea Cheongtaejeon Agricultural System	93.1ha
No.13('19)	Wanju Ginger Traditional Agricultural System	2,252ha
No.14('19)	Goseong Coastal Region Dumbaeng Irrigation System	10,996ha
No.15('19)	Sangju Traditional Dried Persimmon Farming	125,478ha
No.16('21)	Gangjin Yeonbangjuk Ecological Circulation Waterway Agricultural System	5,508ha
No.17('22)	Changwon Dokmae Gam Farming	794ha
No.18('22)	Seocheon Hansan Mosi(Ramie) Traditional Agriculture	18,260ha

KIAHS
18 sites

GIAHS
5 sites



▲ Status of Important Agricultural Heritage of Korea (KIAHS) (© 정나영)

*In the case of fisheries heritage, the nature is different from agricultural heritage, thus necessitating separate research

04 Selecting Ecosystem Service Evaluation Categories for KIAHS

1 Collection of Candidate Ecosystem Service Evaluation categories

Evaluation Categories of Major Domestic and International Ecosystem Service Systems (Partial) ▼

ES Classification	Ecosystem services Category	International			Domestic (Korea)			
		MA(2005)	TEEB(2007)	CICES(2013)	National ES(2016)	National Park ES(2023)	SH Choi (2021)	
Provisioning Services	Food Production	0	0	0	0		0	
	Energy Production/Fuel	0		0	O(Renewable Energy)		0	
	Freshwater/Water Use	0	0	0	0	0	0	
	Raw Material Production/Dietary Fiber	0	0	0			0	
	Biochemicals/Medical Resources		0	0	0	O(Medicinal Plants)		
						O(Endangered Species for Pharmaceutical Production)		
	Genetic Resources	0	0	0				
Decorative Resources			0					
Regulating Services	Climate Regulation (e.g., Carbon Storage)	0	0		0	0	0	
	Air Purification/Air Quality Regulation	0	0	0	0			
	Water Purification	0		0	0	0	0	
	Waste Treatment	0	0	0				
	Flow Regulation	0	0				0	
	Disaster Regulation (e.g., Flood Control, Wind Speed Regulation)	0	0		0	0	0	
	Erosion Control (e.g., Soil Loss Prevention)	0	0		0	0		
	Soil Maintenance and Nutrient Cycling (including Soil Formation)	0	0	0				
	Noise Regulation			0				
	Biological Control	0	0	0	0		0	
	Disease Control (Human)	0						
	Pollination	0	0		0			
Cultural Services	Recreation/Leisure	0	0	0	0	0	0	
	Ecotourism				0		0	
	Healing				0	0		
	Inspiration	0	0		0	0		
	Landscape	0	0		0	0		
	Sense of Place	0						
	Ecological Education	0	0	0	0	0	0	
	Spiritual/Religious Values	0	0	0	0			
	Cultural Heritage/Cultural Resources	0			0	0	0	
Non-use			0					
Supporting Services	Primary Production	0					0	
	Habitat					0	0	
	Ecosystem Diversity		O(Genetic Diversity)	O(Regulating)		0	0	
	Maintenance of Migratory Species Life Cycles		0	O(Regulating)				
	Material Cycling	0					0	
Soil Formation	0							

2 Setting Criteria for Selecting Evaluation categories

To derive the final evaluation categories, prior research was reviewed and selection criteria were established, taking into consideration the characteristics of Korea's National Important Agricultural Heritage Systems.

Selection Criteria	Definition
Institutional Relevance	Whether it is related to the purpose and objectives of the agricultural heritage system.
Representativeness	Whether it fully reflects the characteristics of the system and can represent the functions and roles of the agricultural heritage.
Ease of Data Collection	Whether the time and cost involved in data collection are realistic, and whether the categories and indicators can realistically be collected.
Applicability	Whether realistic improvement measures can be devised based on the evaluation results.

04 Selecting Ecosystem Service Evaluation Categories for KIAHS

3 Selecting Ecosystem Service Evaluation categories

Considering the results of prior research and the characteristics of the National Important Agricultural Heritage, the necessary candidate categories that met the selection criteria were chosen.

**PROVISIONING
3 categories**

**REGULATING
4 categories**

**CULTURAL
5 categories**

**SUPPORTING
2 categories**

Ecosystem services Classification	Ecosystem services Category	Selection Criteria				notes
		Institutional Relevance	Representativeness	Ease of Data Collection	Applicability	
Provisioning Services	Food Production	H	H	M	M	
	Raw Materials (excluding agricultural products)	H	H	L	M	New
	Genetic Resources	H	H	L	M	
Regulating Services	Climate Regulation	H	H	M	L	
	Water Quality Regulation	H	H	M	M	
	Air Quality Regulation	H	H	M	L	
	Disaster Regulation	H	H	M	L	
Cultural Services	Landscape and Aesthetics	H	H	L	H	
	Ecotourism	H	H	L	H	
	Recreation	H	H	L	H	
	Eco-education	H	H	L	H	
	Historical/Cultural Heritage	H	H	L	H	
Supporting Services	Habitat Quality	H	H	H	M	
	Biodiversity	H	H	H	M	

H : High, M : Medium, L : Low

05 Selecting Ecosystem Service Evaluation Indicators for KIAHS

1 Collection of Candidate Ecosystem Service Evaluation Indicators

Ecosystem services Classification	Ecosystem services Category	Candidate Ecosystem Service Evaluation Indicators	Source
Provisioning Services	Food Production	Cultivated Area Crop Production Volume Employment in Crop Production	Raudsepp-Hearne <i>et al.</i> (2011) Layke <i>et al.</i> (2012) Layke <i>et al.</i> (2012)
	Raw Materials (excluding agricultural products)	Non-agricultural Raw Materials (e.g., straw) Sales Revenue Quantity of Non-agricultural Raw Materials	New New
	Genetic Resources	Investment for Exploration of Natural Resources (Cost) Value of Genetic Resources (Cost) Uniqueness of Agricultural Crop Varieties	Layke <i>et al.</i> (2012) Layke <i>et al.</i> (2012) New
Regulating Services	Climate Regulation	Carbon Storage by Type of Land Cover Carbon Dioxide Absorption by Land Cover and Vegetation	National Park Research Institute(2023) National Institute of Ecology(2016)
	Water Quality Regulation	Annual Nitrogen Runoff Rate Pollutant Load at Watershed Outlets and Measured Watershed Discharge Pollution Reduction Using Unit Pollution Load Reduction in Fertilizer and Pesticide Application	HR Jo <i>et al.</i> (2015) National Institute of Ecology(2016) National Institute of Environmental Research(2014) Geum River Basin Environmental Office(2018)
	Air Quality Regulation	Concentration of Gaseous Air Pollutants Concentration of Particulate Air Pollutants Green Volume (Biomass)	National Institute of Forest Science(2017) National Institute of Ecology(2016) SM Lee (2013)
	Disaster Regulation	Annual Surface Water Runoff Rate Soil Erosion Prevention Amount Flood Regulation Amount	HR Jo <i>et al.</i> (2015) National Park Research Institute(2023) National Park Research Institute(2023)
Cultural Services	Landscape and Aesthetics	Aesthetic Quality of Landscape (Structural Diversity, Serenity, etc.) Uniqueness of Landscape	de Groot <i>et al.</i> (2010) National Park Research Institute(2023)
	Ecotourism	Number of Ecotourism Programs Quality of Ecotourism Programs	National Park Research Institute(2023) National Park Research Institute(2023)
	Recreation	Recreational Potential Number of Visitors Number of Healing Programs and Nature Interpretation Programs	Parracchini <i>et al.</i> (2014) National Park Research Institute(2023) National Park Research Institute(2023)
	Eco-education	Potential for Ecological Learning and Education Ratio of Ecological Learning and Education Space Number of Ecological Education Programs Number of Participants in Ecological Education Programs	JW Lee(2021) JW Lee(2021) National Park Research Institute(2023) New
	Historical/Cultural Heritage	Number of Culturally Important Species Presence of Related Cultural Assets Presence of Promotional Materials about the Cultural/Historical Significance	de Groot <i>et al.</i> (2010) National Park Research Institute(2023) New
Supporting Services	Habitat Quality	Biotope Area Ratio Linked to HRI (Habitat Quality Index) Average Size of Habitat Patches Habitat Quality Assessment	Ministry of Environment(2019), National Institute of Environmental Research(2015) MH Gu (2014) National Park Research Institute(2023)
	Biodiversity	Presence of Specific Species or Populations Number of Species and Rare Species	Kandziora <i>et al.</i> (2013) National Park Research Institute(2023)

2 Setting Criteria for Selecting Evaluation Indicators

For the Matrix evaluation to derive the final evaluation indicators, each selection criterion was divided into three scales.

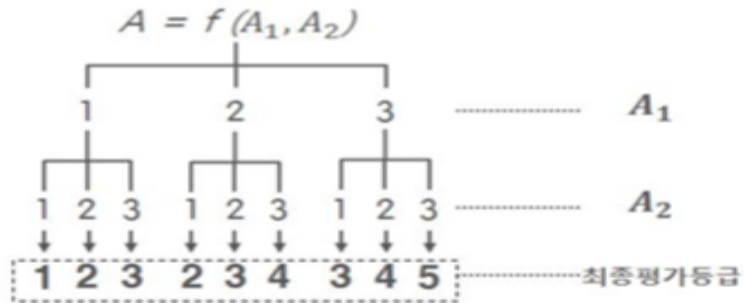
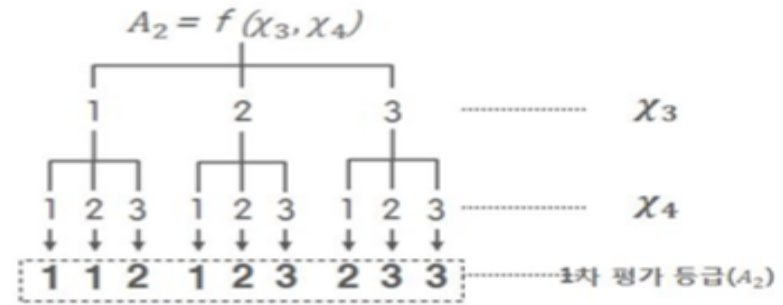
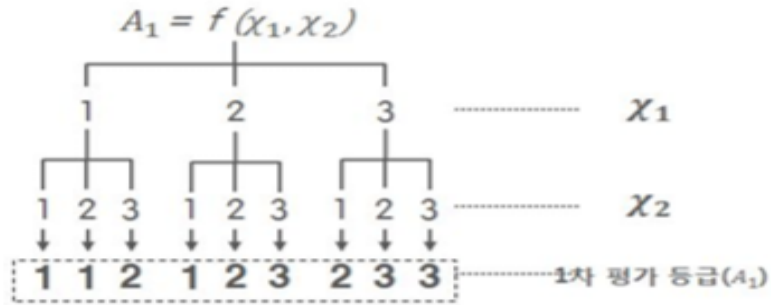
Selection Criteria	matrix	Evaluation Criteria
Institutional Relevance	X1	<ul style="list-style-type: none"> ① Cases directly related to the purpose and objectives of agricultural heritage. ② Cases not directly related but indirectly associated with the purpose and objectives of agricultural heritage. ③ Cases neither directly nor indirectly related to the purpose and objectives of agricultural heritage.
Representativeness	X2	<ul style="list-style-type: none"> ① Cases where all areas can be evaluated with a single indicator. ② Cases where all areas can be evaluated using multiple indicators. ③ Cases where only some areas can be evaluated using multiple indicators, but finding alternative indicators is difficult, thus approximations are used.
Ease of Data Collection	X3	<ul style="list-style-type: none"> ① Cases where data can be collected without field surveys using existing data (statistical data, GIS, etc.). ② Cases where partial field surveys are necessary for data collection, but they require less time and cost (no need for surveys across all four seasons). ③ Cases where field surveys are absolutely necessary for data collection, requiring significant time and cost (surveys across all four seasons needed).
Applicability	x4	<ul style="list-style-type: none"> ① Cases where performance goals can be quantitatively expressed and realistic improvement measures can be devised ② Cases where it is difficult to quantitatively express performance goals, but realistic improvement measures can be devised. ③ Cases where it is difficult to quantitatively express performance goals and to devise realistic improvement measures.

3 Selecting Evaluation Indicators Using Matrix Evaluation

	x1			
		1	2	3
x2				
1		1	1	2
2		1	2	3
3		2	3	3

	x3			
		1	2	3
x4				
1		1	1	2
2		1	2	3
3		2	3	3

	A1			
		1	2	3
A2				
1		1	2	3
2		2	3	4
3		3	4	5



3 Selecting Evaluation Indicators Using Matrix Evaluation

PROVISIONING Services

Ecosystem services Category	Candidate Evaluation Indicators	x1	x2	Primary Grade (A1)	x3	x4	Secondary Grade (A2)	Final Grade (A)
		Institutional Relevance	Representativeness		Ease of Data Collection	Applicability		
Food Production	Cultivated Area	2	2	2	1	2	1	2*
	Crop Production Volume	1	1	1	2	2	2	2*
	Employment in Crop Production	3	2	3	2	2	2	4
Raw Materials (excluding agricultural products)	Non-agricultural Raw Materials (e.g., straw) Sales Revenue	2	2	2	2	1	1	2*
	Quantity of Non-agricultural Raw Materials	2	3	3	3	2	3	5
Genetic Resources	Investment for Exploration of Natural Resources (Cost)	3	3	3	1	2	1	3
	Value of Genetic Resources (Cost)	1	1	1	2	3	3	3
	Uniqueness of Agricultural Crop Varieties	1	1	1	2	2	2	2*

3 Selecting Evaluation Indicators Using Matrix Evaluation

REGULATING Services

Ecosystem services Category	Candidate Evaluation Indicators	x1	x2	Primary Grade (A1)	x3	x4	Secondary Grade (A2)	Final Grade (A)
		Institutional Relevance	Representativeness		Ease of Data Collection	Applicability		
Climate Regulation	Carbon Storage by Type of Land Cover	1	2	1	3	1	2	2
	Carbon Dioxide Absorption by Land Cover and Vegetation	1	1	1	2	1	1	1*
Water Quality Regulation	Annual Nitrogen Runoff Rate	1	2	1	2	2	2	3
	Pollutant Load at Watershed Outlets and Measured Watershed Discharge	1	2	1	3	2	3	3
	Pollution Reduction Using Unit Pollution Load	1	2	1	1	1	1	1*
	Reduction in Fertilizer and Pesticide Application	1	2	1	2	2	2	2
Air Quality Regulation	Concentration of Gaseous Air Pollutants	1	2	1	1	2	1	1*
	Concentration of Particulate Air Pollutants	1	2	1	3	3	3	3
	Green Volume (Biomass)	1	3	2	2	1	1	2
Disaster Regulation	Annual Surface Water Runoff Rate	1	3	2	2	2	2	3
	Soil Erosion Prevention Amount	1	1	1	1	2	1	1*
	Flood Regulation Amount	1	1	1	1	2	1	1*

3 Selecting Evaluation Indicators Using Matrix Evaluation

CULTURAL Services

Ecosystem services Category	Candidate Evaluation Indicators	x1	x2	Primary Grade (A1)	x3	x4	Secondary Grade (A2)	Final Grade (A)
		Institutional Relevance	Representativeness		Ease of Data Collection	Applicability		
Landscape and Aesthetics	Aesthetic Quality of Landscape (Structural Diversity, Serenity, etc.)	1	1	1	3	2	3	3*
	Uniqueness of Landscape	1	1	1	3	2	3	3*
Ecotourism	Number of Ecotourism Programs	1	1	1	3	2	3	3
	Quality of Ecotourism Programs	1	2	1	1	1	1	1*
Recreation	Recreational Potential	1	1	1	3	3	3	3
	Number of Visitors	1	2	1	1	1	1	1*
	Number of Healing Programs and Nature Interpretation Programs	1	2	1	1	1	1	1*
Eco-education	Potential for Ecological Learning and Education	1	1	1	3	2	3	3
	Ratio of Ecological Learning and Education Space	1	3	2	2	2	2	3
	Number of Ecological Education Programs	1	2	1	1	1	1	1*
	Number of Participants in Ecological Education Programs	1	2	1	1	1	1	1*
Historical/Cultural Heritage	Number of Culturally Important Species	1	2	1	2	2	2	2
	Presence of Related Cultural Assets	1	2	1	1	3	2	2
	Presence of Promotional Materials about the Cultural/Historical Significance	1	2	1	1	1	1	1*

3 Selecting Evaluation Indicators Using Matrix Evaluation

SUPPORTING Services

Ecosystem services Category	Candidate Evaluation Indicators	x1	x2	Primary Grade (A1)	x3	x4	Secondary Grade (A2)	Final Grade (A)
		Institutional Relevance	Representativeness		Ease of Data Collection	Applicability		
Habitat Quality	Biotope Area Ratio Linked to HRI (Habitat Quality Index)	1	3	2	1	2	1	2
	Average Size of Habitat Patches	1	3	2	1	2	1	2
	Habitat Quality Assessment	1	2	1	1	2	1	1*
Biodiversity	Presence of Specific Species or Populations	1	3	2	1	1	1	2
	Number of Species and Rare Species	1	1	1	1	1	1	1*

4 Selecting Ecosystem Service Evaluation Indicators

Ecosystem services Classification	Ecosystem services Category	Candidate Evaluation Indicators	Unit
Provisioning Services	Food Production	Cultivated Area Crop Production Volume	ha t/year
	Raw Materials (excluding agricultural products)	Non-agricultural Raw Materials (e.g., straw) Sales Revenue	Won
	Genetic Resources	Uniqueness of Agricultural Crop Varieties	Species
Regulating Services	Climate Regulation	Carbon Dioxide Absorption by Land Cover and Vegetation	tCO2
	Water Quality Regulation	Pollution Reduction Using Unit Pollution Load	kg
	Air Quality Regulation	Concentration of Gaseous Air Pollutants (SO ₂ , NO ₂ , O ₂)	ton/year
	Disaster Regulation	Soil Erosion Prevention Amount Flood Regulation Amount	ton/year mm
Cultural Services	Landscape and Aesthetics	Aesthetic Quality of Landscape (Structural Diversity, Serenity, etc.) Uniqueness of Landscape	Grade Grade
	Ecotourism	Quality of Ecotourism Programs	People
	Recreation	Number of Visitors Number of Healing Programs and Nature Interpretation Programs	people Items
	Eco-education	Number of Ecological Education Programs Number of Participants in Ecological Education Programs	items People
	Historical/Cultural Heritage	Presence of Promotional Materials about the Cultural/Historical Significance	Y/N
Supporting Services	Habitat Quality	Habitat Quality Assessment	Grade
	Biodiversity	Number of Species and Rare Species	Species

In this study, based on prior research and the characteristics of agricultural heritage, we derived 3 categories with 4 indicators for provisioning services, 4 categories with 5 indicators for regulating services, 5 categories with 8 indicators for cultural services, and 2 categories with 2 indicators for supporting services.

Future plans to advance the research include the following:

01

To set effective management goals and develop improvement plans for ecosystem services, it is crucial to have basic data and information about the target sites. Although quantitative evaluations are useful for setting measurable targets, they are limited in assessing cultural services, which require qualitative evaluations as well.

02

It's important to consider both the common and unique characteristics of each agricultural heritage site. This requires a system that reflects these specific traits and discussions about the spatial scope for evaluating ecosystem services.

03

It is planned to verify the selected indicators using methods like the Delphi technique and Focused Group Interviews (FGI). Once the system is established, it will be applied to key domestic agricultural heritage sites to ensure it works in practice.

Policy Applications of the Ecosystem Services Evaluation System

A systematic evaluation framework helps develop strategic plans to both preserve and enhance the ecosystem services provided by agricultural heritage sites.

01 Sustainable Practices Promote agricultural practices like permaculture and organic farming, which maintain ecological balance and enhance biodiversity.

02 Community Engagement Involve local communities in management plans, giving them the knowledge and resources to sustain their cultural heritage while maximizing ecosystem benefits.

03 Policy Effectiveness Assessment Use the framework to evaluate the performance of agricultural heritage management and ecosystem service enhancement policies.

Strategies for managing and enhancing KIAHS, based on understanding ecosystem services and quantitative assessments, enable sustainable management and promote biodiversity and welfare in rural communities. This approach preserves the cultural and historical significance of these sites while maximizing their ecological and economic potential for future generations.



Thank you

